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Forsyth, D. (2006). Determiners of accuracy when making an expected duration estimation: The role of 'past' event/task saliency. (Department of Management and International Business Research Working Paper Series 2006, no. 7). Auckland, NZ: Massey University. Department of Management and International Business.

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<http://hdl.handle.net/10179/636>

Department of
Management
and International
Business

2006, no. 7

Research Working Paper Series

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Determiners of accuracy when making an
expected duration estimation: The role of
'past' event/task saliency

Keywords

Time Management
Scheduling
Duration Estimation
Schematic Memory

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ISSN 1177-2611



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ABSTRACT

One of the important ‘skills’ which is associated with effective time management is the ability to accurately estimate the probable duration of a to-be-scheduled event or task. The present study explored the effect that presenting a highly salient, similar to-be-estimated task had on a subsequent task estimate. Participants in this experiment tended to allocate significantly less time to the completion of a task if they had previously estimated the expected duration of a similar, shorter task. Conversely, they tended to allocate significantly more time to the completion of a task if they had previously estimated the expected duration of a similar but longer task. The results are discussed in relation to future developments in scheduling/time management software.

The ability to accurately estimate the probable duration of a to-be-scheduled event or task is associated with effective time management (Burt & Forsyth, 1999). An 'expected duration' process model developed by Forsyth (2004) suggests that people reach these estimates by 'reflecting' back upon memories of similar tasks. Furthermore the model suggests that this 'reflection' will involve 'reconstructed' events or tasks that will tend to be in the form of schematic event memories rather than reconstructions of a specific event (Michon, 1998; Schank, 1999). One aspect of this process that is likely to effect the resulting expected duration estimate is the degree to which this schematic event memory is 'up-dated' as a result of relevant experience. The present study explored the effect that presenting a highly salient, similar to-be-estimated task had on a subsequent task estimate.

A substantial amount of longitudinal and cross-sectional research has demonstrated importance of effective time management for psychological well-being (e.g., Banks & Jackson, 1982; Feather, 1990; Hepworth, 1980; Kilpatrick & Trew, 1985; Warr & Payne, 1983). Research has demonstrated that poor time management skills are associated with negative outcomes such as high levels of stress (e.g., Goldberger & Breznitz, 1982; Macan, Shahani, Dipboye, & Phillips, 1990; McLaughlin, Cormier, & Cormier, 1988; Schuler, 1979; Tanner & Atkins, 1990; Wratcher & Jones, 1986), low performance/productivity (e.g., Britton & Tesser, 1991; Kleijn, Van der Ploeg, & Topman, 1994; Macan et al., 1990; Wratcher & Jones, 1986), feelings of purposelessness, neuroticism, hopelessness and depression (Bond & Feather, 1988; Feather & Bond, 1983), and less effective group and individual decision making (Benson & Beach, 1996; Kelly, Jackson, & Hutson-Comeaux, 1997).

One of the important 'skills' which is associated with effective time management is the ability to accurately estimate the probable duration of a to-be-scheduled up-coming event or task (Burt & Forsyth, 1999). In relation to this process Forsyth (2004) has developed a model of expected duration estimation which suggests that people will attempt to estimate the expected duration of an upcoming event or task by 'reflecting' back upon memories of similar tasks. The model suggests that this 'reflection' will often involve reconstructing event/s from memory traces (Burt & Kemp, 1994). Additionally, Forsyth (2004) argues that although these remembered events may be 'reconstructed' they will often appear to be a verisimilar representation (Michon, 1990) of a specific event. Furthermore the model suggests that reconstructed events will often be in the form of schematic event memories rather than reconstructions of a specific event (Michon, 1998; Schank, 1999) - although

everyday events are individually encoded they will tend to lose detail and acquire a “schematic or prototypical character” (Michon, 1998, pp. 207).

It is argued that these schematic event memories may be very useful in making an expected duration estimation. As Michon (1990) points out, adult humans have “access to a large repertoire of temporal standards for concrete, everyday, ‘natural’ events, associated with scenarios (scripts, frames), not only in order to efficiently execute routine activities, but also in order to explain and communicate” (p. 43). Similarly, Schank (1999) has proposed that much of human behaviour in everyday situations is guided by scenarios/explicit representations of remembered situations that are sufficiently close to the prevailing situation as to serve as a guide to further action. Over the course of a person’s life they build up a repertoire of useful scenarios (Schank & Abelson, 1977). As each sort of scenario includes an implicit temporal structure (Michon, 1998) a person who is exposed to a similar task will be able to recognise whether it is unfolding in a temporally plausible way.

For example, Burt (1993) demonstrated that an event’s degree of typicality is associated with duration estimation accuracy. Specifically, typicality scores were predictive of both accuracy and whether the estimate was an under or overestimation. Burt’s study provides support for the view that “the magnitude and nature of estimation error, under conditions of substantial retention interval, are related to the typicality of the actual event” (Burt, 1993, pp. 71). In addition, the findings suggest that the effect of actual event memory on duration estimation typically is not sufficient to completely remove the effects of general/typical event duration information.

Research by Yarmey (2000), Burt and Popple (1996), and Burt (1999) address typicality using the retrospective duration estimation paradigm (un-cued estimations of past temporal episodes). Yarmey (2000) undertook an interesting field study of the accuracy of retrospective duration estimates of various invariant (e.g., a computer ‘booting up’) and variant (e.g., talking to a friend) naturalistic events. One of the useful things about this study for the present discussion is that it deals with a wide variety of naturalistic events of varying objective duration (4 seconds to 80 minutes). In line with past research (e.g., Boltz, 1998) he reported that people were significantly more accurate at estimating the duration of invariant events than variant ones. However, this study was somewhat different to what people need to do to estimate expected duration – for example the above study collected duration estimates within seconds of the events’ completion.

Another relevant aspect of schematic event memory proposed by Burt and Popple (1996), and expanded upon by Burt (1999), is the effect speed of action has on retrospective

duration estimates. Specifically Burt (1999, pp. 353) suggested “the faster the actions in an event are perceived to be, the shorter the estimated event duration”. For example, Burt and Popple (1996) demonstrated that people tend to use their general knowledge concerning the relationship between the speed of action and its duration. They showed that participants who were led to believe an event involved running instead of walking provided retrospective duration estimates which were significantly shorter. Similarly, Burt’s (1999) second experiment had participants view a 76-second video of a bank robbery before one group was asked to retrospectively estimate the duration of the video and write a narrative describing it straight after viewing, while another group were required to return the next day before being prompted for the same information. One of the main findings of this study was that there was a large degree of variation between the wording participants used to describe the robbery and also variability in the estimated duration. However, somewhat surprisingly, there was no significant difference between the immediate group and the delayed group on either of these measures. Overall there was a general trend toward overestimating the duration of the robbery in both groups. The results revealed a significant negative correlation between the number of action words used and the participants’ estimate of the robbery’s duration – more action words, shorter duration judgement. Unfortunately the results did not allow for conclusions to be made as to the relationship between the ‘speed’ (i.e., charged vs. pushed vs. passed) of the action words used and the duration judgement. It would be expected that there would have been a significant interaction effect between the ‘speed’ of the words used, the total number of action words used, and the duration estimation.

Burt (1999) suggested the direction of the causation of this effect is from the construction of the narrative that describes the event to estimating the events duration. This interpretation is in line with the view that retrospective duration estimates tend to be based on reconstructive and constructive processes (Burt, 1992, 1993; Burt & Kemp, 1991).

As far as expected duration estimation is concerned, an interesting set of experiments that shed light on the effect of semantic event memory was undertaken by Josephs and Hahn (1995). They suggested that when people are required to estimate expected duration (of various academic type tasks) they tend to trade accuracy in favour of minimising cognitive effort. Their series of studies focused on the quality of information the schedulers received. Overall they found that participants tended to base their estimates on task features that required the least amount of computational effort to process. The resulting accuracy of such estimates was to a large degree dependant on the diagnostic value of these features.

In their first study Josephs and Hahn (1995) asked students to estimate how long they would need to complete a written assignment of either four single-spaced pages or seven double-spaced pages. As predicted students on average allotted significantly more time to the completion of the seven-page assignment even though it contained fewer words. They explained these findings in terms of the fact that although pages are less diagnostic than number of lines they are computationally easier.

In their second study Josephs and Hahn (1995) found students estimated the completion of significantly fewer anagrams when each anagram was attached to the front cover of a journal (hence the anagram looked 'bigger'). They suggested that this was because the most salient feature of this task was the size of the 'pile' of anagrams, and so people would use this information on which to base their estimate. One interesting issue is that although they suggest that reducing cognitive effort by relying on surface features of the to-be-estimated task tends to result in people vastly underestimating required duration, this study in fact shows the opposite. In both cases participants completed substantially more (in the order of 2-3 times more) anagrams than they had estimated, in both cases vastly overestimating the actual duration required to complete each anagram.

Their third study reported a similar conclusion – people place more weight on page length than more useful, but cognitively taxing, information like font and margin size when estimating the expected duration of reading. In a similar vein are studies demonstrating that people are more likely to complete and return a questionnaire if it is formatted onto fewer pages (see Hornik, 1981).

Although Josephs and Hahn (1995) explain their findings in terms of minimising cognitive effort, another way to look at it is in terms of typicality of to-be-estimated tasks or events, whereby more typical ones were estimated with greater accuracy. For example, when asked to estimate how long it would take you to read the paperback novel in front of you, your accuracy would be dependant on how typical the book's attributes were – its font type and size, its grammatical complexity, its paper thickness, the size of its margins. In the first study single-spacing may have been more typical of what students were required to do. Likewise, it is a very atypical situation to have to complete anagrams attached to the cover of journals.

In summary, it is argued that schematic event durations appear to be stored in memory as part of general event memory and that this schematic duration is used as part of the expected duration estimation process. Additionally, the nature and accuracy of this schematic

event duration is determined by the amount of experience/frequency of exposure to the particular type of event.

Inherent in this view is that people will vary in their ability to perceive and judge typicality (the level of congruence with the relevant schematic event memory) of to-be-estimated tasks. As mentioned, Burt (1993) demonstrated that an event's degree of typicality is associated with duration estimation accuracy. Specifically, his study found that events that were atypically long tended to be underestimated, whereas events that were atypically short were overestimated. It appears that specific event duration estimation information in general is not sufficient to completely remove the effects of general/typical event duration information. Overall, people appear to underestimate the degree of atypicality.

One aspect of typicality that has not been addressed is the number of presentations required to 'build' a schematic event memory, and the effect of saliency (in the form of recency) in updating a schematic event memory. Most research in this area has looked at typicality, which has been built up over many years of experience and over numerous presentations. For example, the relationship between the speed of action and duration (Burt & Popple, 1996), between the number of action words used and the participants' estimate of the robberies (Burt, 1999), and standard formatting of printed material (Josephs & Hahn, 1995).

However, given the fact that people appear to adopt estimation strategies that minimise cognitive effort (Josephs & Hahn, 1995) it may be the case that saliency of past similar experiences may be a crucial factor in determining typicality. More specifically, it may be the case that a single (recent) exposure to a similar expected estimation experience may alter/affect a future expected duration estimation by 'up-dating' the schematic event memory (Burt, 1993).

It is argued that a high degree of saliency (in the present case, specifically in the form of recency) will have a similar effect to that of repetition in the formation of a schematic event memory and associated duration. Further, it is argued that a person need not have experienced the specific task or its 'duration' (i.e., actually completed the task or experienced the event) in order to update schematic event memory, in that the person will most likely reconstruct a type of verisimilar representation of what they believe the task entails. To test these ideas the present experiment required participants to either estimate the expected duration of a short 'version' of a task followed by a longer version or vice versa. Based on the research reviewed above the following hypothesis was proposed:

The order of presentation of task, which only vary with respect to scale (e.g., 10 pages of proofreading as opposed to five pages of proofreading), will have a significant effect on the time participants allocate to the tasks' completion. Specifically, participants will allocate significantly less time to the completion of a task if they have previously estimated the expected duration of a shorter similar task. Conversely, they will allocate significantly more time to the completion of a task if they have previously estimated the expected duration of a similar but longer task.

METHOD

Experiment design overview

The experiment consisted of two between-group conditions. In condition one, participants were required to estimate the duration of four tasks which were presented in the following order – short version of balance task, long version of balance task, short version of proofreading task, long version of proofreading task. In condition two participants were also required to estimate the duration of the same four tasks, however they were presented in a different order from condition one – long version of balance task, short version of balance task, long version of proofreading task, short version of proofreading task.

Participants

Eighty people, with a mean age of 20.8 years, undertaking a stage one psychology course at the University of Canterbury, participated in this experiment. Forty were randomly assigned to each of the two conditions. The first condition contained 12 males and 28 females, while the second condition contained 10 males and 30 females. The University of Canterbury human ethics committee approved the experiment.

Materials

As mentioned above each of the two conditions were made up of the same two versions of a balance and proofreading task. As shown below the two versions of each task differed only in magnitude. The two conditions varied in respect to the presentation order of the short and long versions of each of the two types of tasks – in condition one the short version of each task was presented before the long version of the task. In contrast, in condition two the long version of each task was presented before the short version of each task. The four tasks are listed below in the form in which the participants received them (task headings were omitted in experimental materials).

Balance task short version:

Five ‘bills’ (e.g., power bill, phone bill) are provided, along with an account balance sheet. Your task is to enter the ‘billed amount’ in the debt column and subtract the amount from the balance, creating a new balance after each subtraction (pen and paper subtraction - no calculator).

Balance task long version:

Twenty ‘bills’ (e.g., power bill, phone bill) are provided, along with an account balance sheet. Your task is to enter the ‘billed amount’ in the debt column and subtract the amount from the balance, creating a new balance after each subtraction (pen and paper subtraction - no calculator).

Proofreading task short version:

A three-page document typed (double-spaced) on A4 paper is provided. Your task is to proofread it for spelling mistakes. Circle each spelling mistake that you find.

Proofreading task long version:

A 13-page document typed (double spaced) on A4 paper is provided. Your task is to proofread it for spelling mistakes. Circle each spelling mistake that you find.

A space was provided below each of the four tasks for the participant to enter their expected duration estimate. No temporal scale prompts were provided – no hour, minute, or second prompts.

Procedure

Potential participants from stage one psychology laboratories were invited to take part in a study requiring them to estimate how long they thought it might take them to complete four office-type tasks. Interested participants were randomly assigned to one of the two conditions outlined above. Participants were informed that they were to assume they worked in an office-type environment and that they were required as part of their job to complete four tasks. They were also asked to assume that they had the equipment/resources to complete the tasks. Each participant received a self-explanatory questionnaire outlining the requirement to estimate how long they thought it would take to complete each of the four tasks. After each written description of a task, a space was provided in which to enter their estimation. Following completion participants were debriefed and thanked for their participation.

RESULTS

The first, second and third numerical columns of Table 1 show the average, the median, and the range of expected duration estimates for the four tasks for each of the two conditions.

Insert Table 1 about here

A 2x4 mixed design ANOVA, with the order of presentation (either long tasks first or short tasks first) being the between subject variable and the duration estimates for the four tasks being the within subject variables, was conducted to see whether these difference were significant (Figure 1 depicts the relationship between these variables). The ANOVA revealed a significant main effect for order of presentation ($F(1,78) = 6.61, p=.012$) and for the different tasks ($F(3,234) = 34.66, p=.000$), however the interaction between these two did not reach significance ($F(3,234) = 2.50, p=.06$). More specifically, planned comparisons revealed significant differences between whether the short task was presented first or second for three of the four tasks – short balance ($F(1,78) = 8.00, p=.005$), long balance ($F(1,78) = 7.32, p=.008$), and long proofread ($F(1,78) = 4.08, p=.046$) - short proofread ($F(1,78) = 2.48, p=.11$) did not reach significance.

Insert Figure 1 about here

Overall these results suggest that more time is allotted to relatively short tasks when they are presented after a longer similar task. Conversely, it appears that less time is allocated to the completion of a relatively long task if it is preceded by a shorter task. Strengthening this view, the pattern is consistent across both types of tasks – balance and proofreading.

DISCUSSION

This study demonstrated that presenting a highly salient similar to-be-estimated task can affect a subsequent task estimate. Overall there was support for the hypothesis, in that participants tended to allocate significantly less time to the completion of a task if they had previously estimated the expected duration of a shorter similar task. Conversely, they tended to allocate significantly more time to the completion of a task if they had previously estimated the expected duration of a similar but longer task.

These results could be interpreted as suggesting that schematic event memories can potentially be 'adjusted' with a single presentation of a similar task. Although further research is required one can speculate that the 'power' of this single presentation lies in its saliency, in that if participants were required to estimate the completion of the similar task the day before, rather than immediately before, it would not have had such a large effect (if any) on the estimation. Additionally, following on with a 'change in schematic memory' type interpretation of the experimental results, and in line with the reconstructive process involving a verisimilar representation advocated in the introduction, the 'up-dating' of schematic event memories appear to occur even when the person has not actually 'experienced' the event firsthand.

Although a lot more research is needed to fully understand the role schematic event memory plays in expected duration estimation, it is interesting to speculate whether it may be feasible to develop an algorithm for scheduling software that could 'measure' the degree of task typicality and adjust the estimate accordingly. Such an algorithm would need to effectively classify tasks (both type and temporal magnitude) and 'predict' individual response biases in relation to the tasks' typicality (probably based on a combination of the number of exposures and relative saliency of a similar 'class' of task). The measure of typicality would be developed over time by recording and analysing the effectiveness of previous scheduling. To be truly effective it would also have to take into account the person's awareness of the degree of typicality in relation to their schematic event memory for that 'type' of task (i.e. is the person already adjusting the estimate appropriately?). Again, this would need to be achieved by recording and analysing the effectiveness of previous scheduling.

Additionally, one of the interesting and largely unexplained processes evident in most other non-temporally cued expected duration estimation research is that people appear to be

able to choose and adjust the temporal ‘scale’ of their expected duration estimation (Burt & Forsyth, 2001; Forsyth, 1998, 2004). Given the difficulty of making expected duration estimates it is somewhat surprising estimators are as effective as they are at choosing an appropriate scale. It is argued that this choice involves, along with other task and estimator variables (such as experience at making duration estimates and temporal bounding effects), an analysis of the task typicality in relation to the person’s schematic event memory for that type of task. Similarly, the pattern of results may partly be a consequence of people choosing their scale values based on the first task. Therefore, if a short task is first then people will use a smaller scale/prototypical temporal value, meaning they will tend to allocate less time for the following longer task, and vice versa for long tasks that are first.

In conclusion this experiment has demonstrated that the scheduling of an earlier similar task can affect the amount of time allocated to a task. It has been suggested that this effect could be due to an updating of schematic event memory, in that the process of estimating the duration of the first task potentially affects memory in a similar way to actually having completed it.

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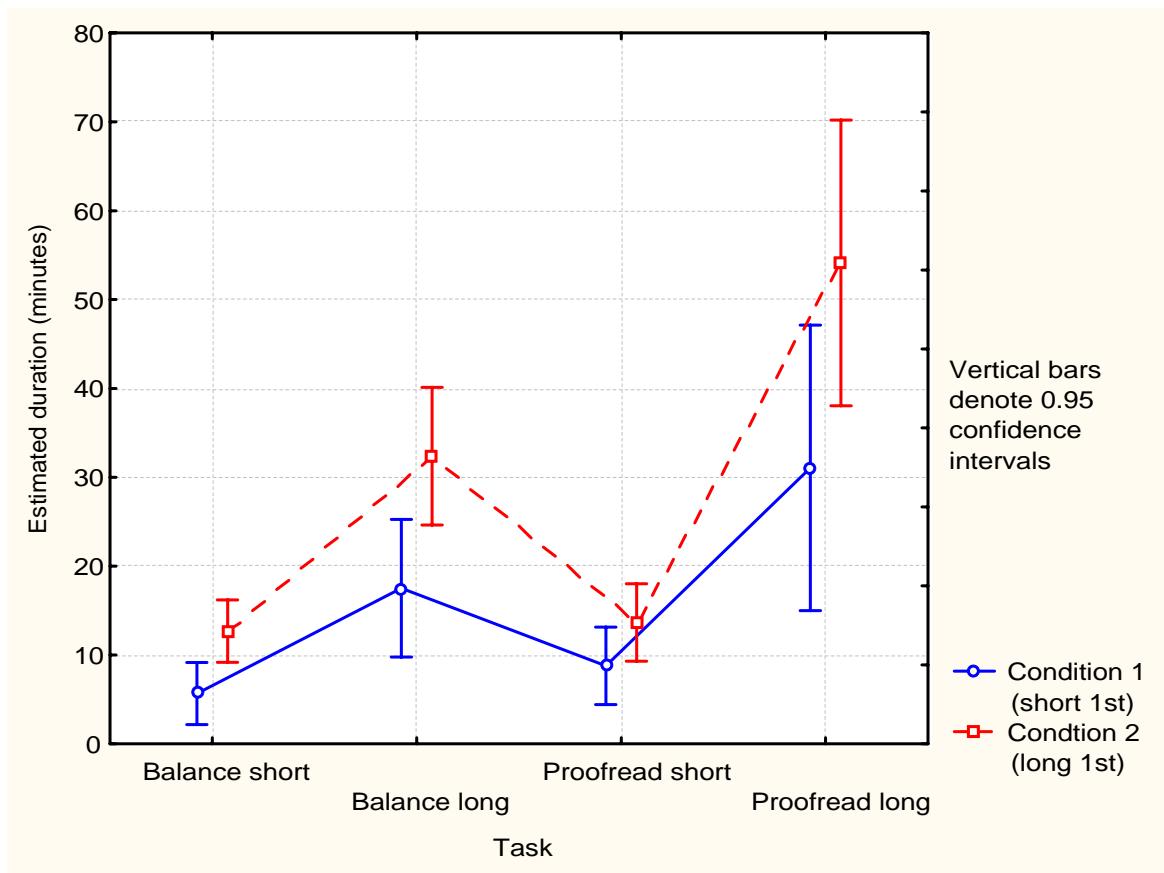
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Table 1. The effect of presentation order of tasks that vary in magnitude on expected duration estimation

	Order of Presentation	Mean Estimated Time (&SDs) to Complete (Seconds)	Median Estimated Time to Complete (Seconds)	Range of Estimated Times to Complete (Seconds)
Short Balance Sheet	Presented first (condition 1)	339 (232)	300	60 – 1200
	Presented second (condition 2)	760 (913)	570	60 – 5400
Long Balance Sheet	Presented first (condition 2)	1942 (1957)	1200	300 – 9000
	Presented second (condition 1)	1050 (718)	900	180 – 3600
Short Proofread	Presented first (condition 1)	526 (214)	600	180 – 900
	Presented second (condition 2)	819 (1152)	870	180 – 7200
Long Proofread	Presented first (condition 2)	3247 (4242)	2100	720 – 21600
	Presented second (condition 1)	1863 (877)	1800	600 - 3600

Figure 1. A graphical representation of the relationship between the two conditions in Experiment 1 and the estimated duration of the four tasks.



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2006

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